# Use of $tcPo_2$ for Evaluation of Right to Left Shunts in Patent Ductus Arteriosus

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The need for close control of oxygenation in the sick newborn infant, particularly when born preterm, is widely recognized. Poor oxygen control has been linked not only with retrolental fibroplasia but also such conditions as spastic diplegia and other neurologic defects. Despite the significance of these problems, most infants are managed on the basis of intermittent blood samples drawn from indwelling aortic catheters. The blood flow in the lower aorta is clearly past the level of the ductus arteriosus and therefore if a patent ductus exists and has right to left flow, samples obtained from the lower aorta can be very misleading regarding the $Po_2$ reaching the brain and eyes.

The development of the transcutaneous $Po_2$ electrode has provided an improved method for evaluation of the oxygenation of these infants since the $Po_2$ analysis is both continuous and non-invasive. $tcPo_2$ monitoring has also provided a technique for the assessment of right to left shunts through the ductus.

Yamanouchi first described this technique(1). Two $tcPo_2$ electrodes are placed on an infant suspected of having a right to left shunt through the ductus arteriosus. One electrode is placed on skin receiving its blood supply from pre-ductal blood, usually right upper chest, and the other electrode is placed on skin receiving its blood supply from post-ductal blood, usually the lower abdomen.

We have used this technique to assess the incidence and significance of right to left shunts in preterm infants. We studied 31 infants, birth weights 800-2470 gms, gestational ages 27-36 wks. We continously monitored heart rate, $tcPo_2$ (right chest), $tcPo_2$ (lower abdomen) and thoracic impedance. The difference between the two $tcPo_2$ measurements was recorded during rest and during crying. A difference of 10 % between the two measurements was defined as evidence of a shunt and the validity of the difference was confirmed by alternating electrodes. Infants were studied in the first hours of life, on day 2 or 3 and at 1 week.

Fig 1 shows the percent difference in $tcPo_2$ measurements (R chest-abdomen) in infants with evidence of shunt.

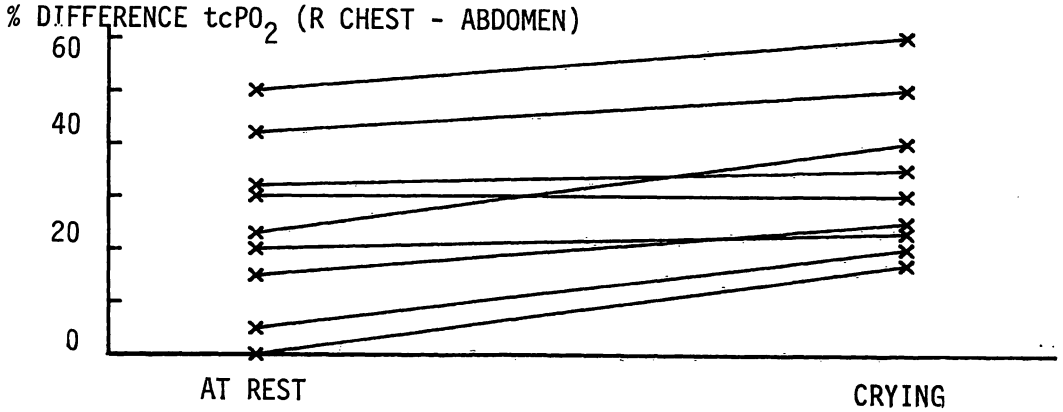


Fig 1: % Difference $tcPo_2$ (R chest-abdomen) in 9 infants measured at rest and during crying.

0300-5577/81/0091-0033 $ 2.00

Of the 31 infants, 7 had a greater than 10 % difference between the electrode measurements during rest and 9, during crying. This observation is particularly important in regard to blood samples obtained by arterial or capillary puncture in areas supplied by post-ductal blood. During the crying which inevitably accompanies puncture, blood samples from post-ductal blood are particularly misleading.

All seven infants with evidence of shunt at rest showed an increase in the size of shunt in days 2-3 compared to the first few hours of life. One infant with a large right to left shunt and severe IRDS died at 4 days of age. Of the surviving six, all showed a decrease in the right to left shunt by 5-7 days of age, with only one maintaining a greater than 10 % difference.

We have also used the two electrode technique to assess the response to therapy for pulmonary hypertension. One of the largest discrepancies in right chest-lower abdomen $tcPo_2$ was seen in a 1730 gm. infant with history of severe birth asphyxia, admission pH 7.01, and severe IRDS requiring assisted ventilation His $tcPo_2$ tracing before treatment is shown on the left of Fig. 2. He has given an infusion of Tolazoline (Priscoline®) and its effect on the right to left shunt can be seen in the right of the Fig. 2.

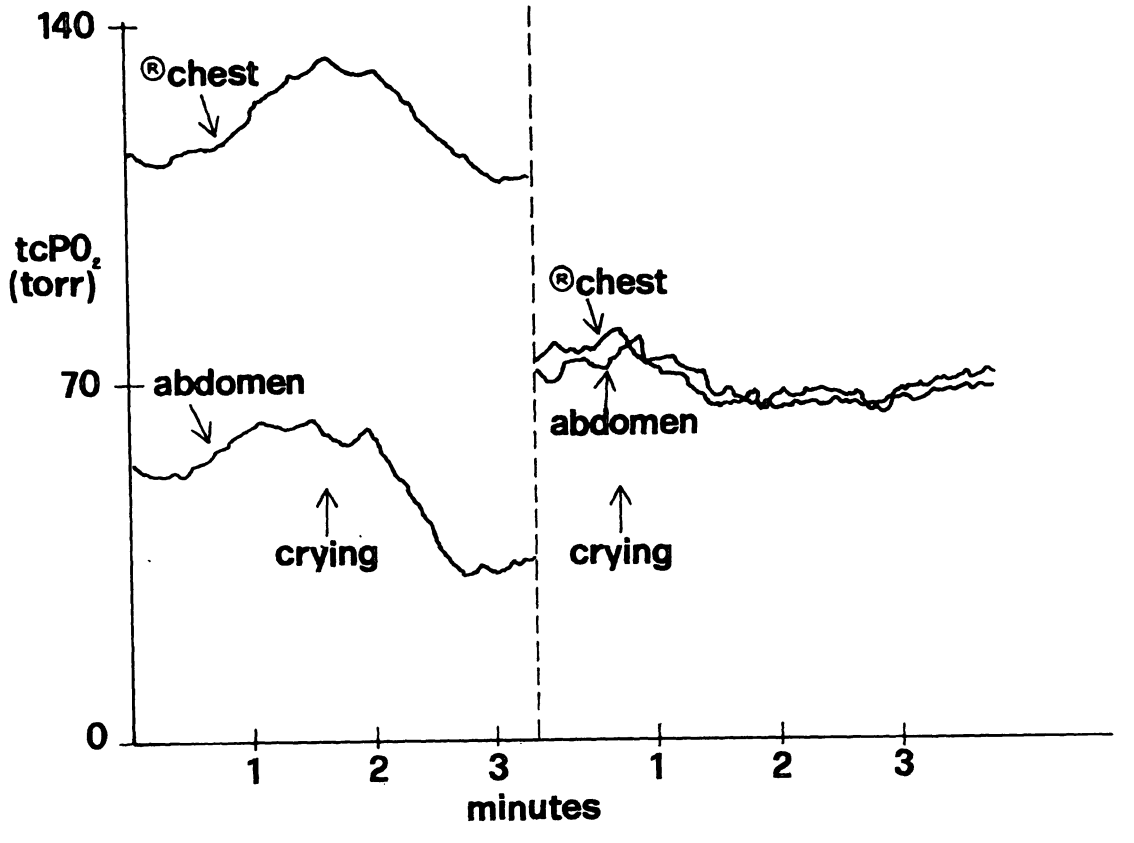


Fig. 2: Polygraphic tracing of right chest and lower abdomen $tcPo_2$ before and after infusion of Tolazoline.

We conclude that approximately 25 % of preterm infants show some evidence of right to left shunting at the ductal level in the first days of life. In many, the size of the shunt is physiologically insignificant. However, in the small preterm infant in whom control of oxygenation is critical, recognition of the possibility of right to left shunting and the resulting misleading information from post-ductal blood analysis, must be made. Furthermore, the two electrode technique can be helpful in assessing the size of right to left shunts and in assessing the response to therapy for pulmonary hypertension, such as Tolazoline (Priscoline®).

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